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Multistate Outbreak of *Salmonella* Serotype Tennessee Infections Associated with Peanut Butter --- United States, 2006--2007

In November 2006, public health officials at CDC and state health departments detected a substantial increase in the reported incidence of isolates of *Salmonella* serotype Tennessee. In a multistate case-control study conducted during February 5--13, 2007, illness was strongly associated with consumption of either of two brands (Peter Pan or Great Value) of peanut butter produced at the same plant. Based on these findings, the plant ceased production and recalled both products on February 14, 2007. The outbreak strain of *Salmonella* Tennessee subsequently was isolated from several opened and unopened jars of Peter Pan and Great Value peanut butter and from two environmental samples obtained from the plant. New case reports decreased substantially after the product recall (Figure 1). As of May 22, 2007, a total of 628 persons infected with an outbreak strain of *Salmonella* serotype Tennessee had been reported from 47 states since August 1, 2006 (Figure 2). Local and state public health officials in multiple states, with assistance from CDC and the Food and Drug Administration (FDA), are continuing to investigate this outbreak caused by peanut butter, a new food source for salmonellosis in the United States. All remaining jars of Peter Pan or Great Value peanut butter with a product code beginning with 2111 should be discarded.

Public health officials in PulseNet (the molecular subtyping network for foodborne disease surveillance) and OutbreakNet (the network of public health epidemiologists who investigate foodborne illnesses nationwide) have been investigating this outbreak and attempting to identify the mechanism of initial contamination. The investigation began in November 2006, when public health officials in PulseNet noted a substantial increase in the number of isolates of the outbreak strain of *Salmonella* serotype Tennessee; throughout 2005 and most of 2006, these isolates were reported to PulseNet at a rate of one to five per month, whereas in October 2006, 30 isolates were reported. Pulsed-field gel electrophoresis (PFGE) patterns of *Salmonella* Tennessee strains isolated from patients were uploaded from state health department databases to CDC databases. Three closely related patterns* were determined to be associated with this outbreak.

A case was defined as infection with *Salmonella* Tennessee with a PFGE pattern matching one of the three outbreak patterns in a person residing in the United States with symptom onset on or after August 1, 2006 (or, if onset date unknown, *Salmonella* Tennessee isolated on or after August 1, 2006). The median age of patients was 52 years (range: 2 months--95 years); 73% were female. Symptoms of infection included diarrhea (72%), abdominal cramps (65%), fever (43%), and dysuria (45%). Symptom onset dates were known for 481 of 628 patients and ranged from August 1, 2006 to April 23, 2007 (Figure 1). Twenty percent of patients were hospitalized; no deaths were attributed to *Salmonella* infection. Sixty-one percent of isolates were from stool specimens, 35% from urine specimens, and 4% from other specimens.

The initial investigation indicated that cases were not clustered geographically, and patient interviews conducted during November--December 2006 by state and local officials from OutbreakNet did not reveal a common food exposure. Officials in multiple states then interviewed 26 patients in January 2007 using a standard food-consumption survey instrument of approximately 200 items. Interviews indicated that 48% of the patients had eaten turkey (excluding delicatessen-sliced

turkey) and 85% had eaten peanut butter during the week before illness onset, higher proportions than would be expected from food-consumption surveys of the U. S. population (*1*).

In February 2007, a case-control study with 65 patients and 124 controls was conducted to identify the food item associated with illness; the majority of interviews were completed by state and local health departments and were coordinated by CDC. For the study, a case was defined as infection with the outbreak strain of *Salmonella* Tennessee in a person aged ≥18 years with a history of diarrhea. Controls were well adults from the patient's community who were matched by geographic location. Controls were identified using a reverse online telephone directory that when given an address provided telephone numbers for residences in the same extended neighborhood as the patients. The median ages for the patients and controls were 53 and 58 years, respectively. Patients were more likely than controls to have eaten peanut butter (81% versus 65%, matched odds ratio [mOR] = 1.9, 95% confidence interval [CI] = 0.8--5.2), to have eaten peanut butter more than once a week (66% versus 40%, mOR = 3.5, CI = 1.4--9.9), and to have eaten either Peter Pan or Great Value peanut butter (67% versus 13%, mOR = 10.9, CI = 3.8--43.0). Neither the consumption of other peanut butter brands nor consumption of turkey products was associated with illness.

Epidemiologic data suggesting Peter Pan brands of peanut butter as the possible source of the outbreak were provided to FDA officials on February 13, 2007. The following day, FDA issued a health alert to consumers indicating that they should not eat Peter Pan or Great Value peanut butter with a product code beginning with 2111, both of which were manufactured in a single facility in Georgia operated by ConAgra Foods. ConAgra Foods voluntarily recalled the products, destroyed existing products in their possession, and temporarily halted production pending further investigation.

New case reports decreased substantially after the February 14 recall (Figure 1). Investigation of the cases is ongoing to determine whether persons are still eating peanut butter from contaminated lots.

Subsequent laboratory testing of leftover peanut butter from patients was performed at state public health laboratories and CDC. *Salmonella* Tennessee with a PFGE pattern matching one of the outbreak strains was isolated from 21 opened and unopened peanut butter jars with production dates ranging from July 2006 to December 2006. These jars were collected from patients in 13 states (Arkansas, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Minnesota, New York, Oklahoma, Pennsylvania, South Carolina, and Tennessee); two of the PFGE strains were isolated from these peanut butter samples. FDA isolated *Salmonella* Tennessee from 13 unopened jars of Peter Pan and Great Value peanut butter with production dates ranging from August 2006 to January 2007 and from two plant environmental samples. Peanut butter from the Georgia plant was exported to 70 countries. No confirmed cases linked to this outbreak have been reported from other countries, although several possibly related cases have been investigated.

The source of the peanut butter contamination is unknown. FDA is investigating the plant operations, including heating temperatures, to determine the mechanism.

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Editorial Note:

Approximately 2,500 *Salmonella* serotypes can cause salmonellosis, an illness characterized by diarrhea, fever, and abdominal cramps, typically 12--72 hours after infection (*2*). *Salmonella* Tennessee infections are rare, and the source of most of these infections is unknown. An average of 52 *Salmonella* Tennessee cases were reported to the National *Salmonella* Surveillance System† each year during 1995--2004, representing 0.1% of all reported *Salmonella* strains (*3*). Only one other outbreak of *Salmonella* Tennessee infection with an identified food source, contaminated powdered milk, has been reported to CDC (*4*). In addition to causing gastrointestinal symptoms, certain serotypes, including *Salmonella* Tennessee, are more likely than other serotypes to infect the urinary tract. The percentage of patient *Salmonella* Tennessee isolates from urine specimens increased from 15% during 1995--2004 to 27% during 2005--2006. Because urinary tract infections

are more common among females, the high proportion of isolates from urine in this outbreak might explain the high percentage of identified cases among females (*3*,*5*).

This is the first reported outbreak of a foodborne illness caused by peanut butter consumption in the United States. Outside the United States, one outbreak implicating peanut butter, caused by *Salmonella* serotype Mbandaka, was reported from Australia in 1996 (*6*). In addition, an outbreak of *Salmonella* serotype Agona infection in four countries was associated with consumption of a peanut-butter--coated snack produced in Israel (*7*,*8*).

Peanuts can become contaminated with salmonellae during growth, harvest, or storage, and the organisms are able to survive high temperatures in a high-fat, low-water--activity environment (*9*). Peanut butter provides such an environment, and although it typically undergoes heat treatment to temperatures >158°F (>70°C), such heating might not always eliminate salmonellae (*10*). In addition, after heat treatment, peanut butter that is being processed might be contaminated by salmonellae that are introduced into the production environment on raw peanuts or another source (e.g., animals in the production plant, salmonellae brought into the plant on containers or humans from the outside environment, or other ingredients used to make peanut butter).

This outbreak demonstrates the potential for widespread illness from a broadly distributed contaminated product, one that has not been previously implicated in a foodborne illness outbreak in the United States. In addition, the outbreak demonstrates that processed food can become contaminated even when the production process includes a heat-treatment step, underscoring the need for effective preventive controls in food-processing plants to prevent contamination.

Certain consumers might still be eating peanut butter from contaminated lots. All remaining jars of Peter Pan and Great Value peanut butter with a product code beginning with 2111 should be discarded.

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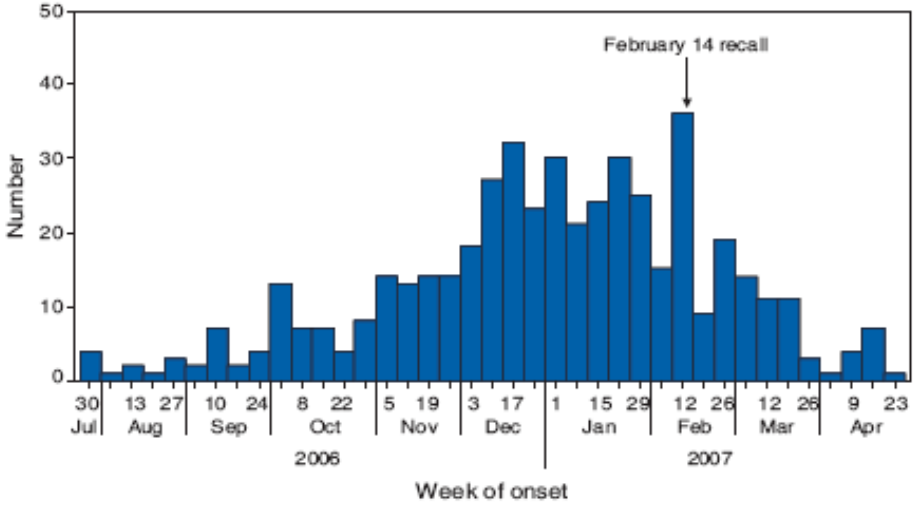
* CDC PulseNet patterns JNXX01.0010, JNXX01.0011, and JNXX01.0026.

† The National *Salmonella* Surveillance System collects information on serotypes of *Salmonella* isolates reported through the Public Health Laboratory Information System, an electronic reporting system. Additional information is available at http://www.cdc.gov/ncidod/dbmd/phlisdata/salmonella.htm.

Figure 1

FIGURE 1. Number of confirmed cases (n = 481)* of *Salmonella* Tennessee infection associated with consumption of peanut butter, by week of symptom onset — United States, August 1, 2006–April 23, 2007



* Cases with outbreak-associated pulsed-field gel electrophoresis pattern and for which date of symptom onset was available.

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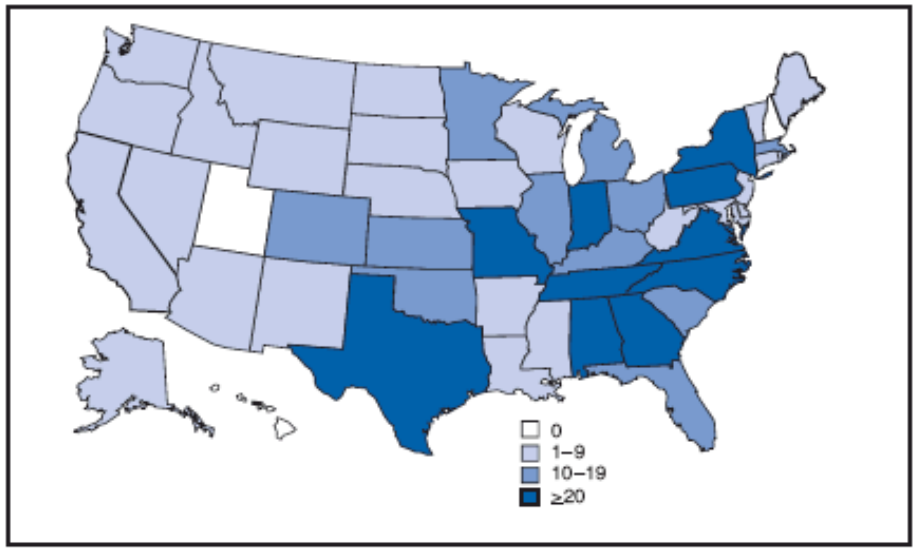
Figure 2

FIGURE 2. Number of confirmed cases (N = 628)* of *Salmonella* Tennessee infection associated with consumption of peanut butter, by state — United States, August 1, 2006–May 22, 2007



*Cases with outbreak-associated pulsed-field gel electrophoresis pattern.

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